Various Methods of Moving Object Detection Techniques in Vehicular Environment

T. S. Balaji, S. Srinivasan

Abstract: ***With the invention of autonomous vehicles, it make easier to know about the future directions of the vehicles. The main purposes of vehicle detection and tracking are to identify the on-road traffic conditions, hazards or hurts as well as to communicate with other on-road vehicles/objects. To meet the above requirements, the following methodologies are useful which are like Fuzzy based, Radar and V2V fusion, Background subtraction, Active contour, Single learning based method and etc., Those methodologies are implementing either independently or collaboratively may lead to focus towards not only on the vehicles and other objects of our interest. In order to track the vehicles, first to detect the various objects and from them only it is possible to identify the vehicle objects. After the identification of vehicular objects, we can segregate them according to their sub-category. In this paper, various object/vehicle detection techniques have been discussed. The process of segmentation and separation of vehicle objects and its types can be possible by implementing a certain fuzzy rules. Detection of an object using various fusion techniques makes more effective in terms of obtaining the information regarding that particular vehicle directly or via nearby vehicles. While capturing the object, there is a possibility of false detection. This can be avoided by clearly eliminating the shadows, illumination and etc., from capturing object image. This kind of elimination process is termed as background subtraction. Active contour is one another detection method which gives us succession of images from which the internal and external borders of several objects can be identified. By a single extraction various objects are identified and then given to different detectors according to their sub-category. All these kind of techniques are discussed in this paper.***

Keywords: Fuzzy Rule, Background Subtraction, Fusion, Single extraction.

I. INTRODUCTION

With the invention of Advanced Driver Assistance System (ADAS), it is essential to know about the V2V communication. It allows the exchange of information with another single vehicle or group of vehicles, roadside unit and any other infrastructure. Exchange that information will enhance safety of the driver, comfort and efficiently know the future trajectories of the road conditions. Along with other parameters driving safety is the very important in the design of future Intelligent Transportation System (ITS) [1,2]. Vehicles can understand its surrounding medium by detection of intelligent vehicle and continuously tracking of that vehicle on the highways. Vehicle detection and tracking can be carried out with the help of on-board sensors, cameras, GPS, Dedicated Short Range Communication [8] (DSRC), radars [3], LIDAR and etc.,

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Sometimes, it can also be carried out by capturing of images and with the contour of those images, various vehicles can be distinguished[10]. From the connected vehicles the data is received, processed and re-transmit the relevant information to the required vehicle in vehicular environment. On-board sensors alone are not efficient at all the times to exchange the information from connected vehicles. Suppose if the road surface is planar [5], the On-board sensors are utilized which also face certain limitations like detection range, angle of view [8], type and quality of sensors. But, the road surface is not planar at all the circumstances during which at that moment off-board sensors like Unmanned Arial Vehicle (UAV) is utilized[5]. The presence of various obstacles like huge buildings, trees, traffic signal post, lamp post and etc., leads to provide the false information to the connected vehicles which must be avoided during the exchange of information [6,12]. The combination of various On-board and Off-board sensors information must be compared and then end-stage decision will be taken for accurate detection of vehicle [4].

II. RELATED WORKS

Xiao Wang et al [4] proposed the paper "On-road vehicle detection and tracking using MMW Radar and Monovision fusion" This paper focuses on collaborative fusion method of different sensors in order to achieve the optimal balance between the vehicle detection accuracy and computational efficiency[4]. In human vision system, the rods and cones are the two different types of cells. Rods are highly sensitive to moving objects whereas cones are highly sensitive to colour and texture [4]. With these two different cells, the position of the obstacle and tracking can be done. Like human vision system, the trajectories which were generated by vision and radar system are compared and verified for improving the overall accuracy of vehicle detection and tracking [4].

Liang Wang et al [5] proposed the paper "Detecting and tracking vehicles in traffic by unmanned aerial vehicles" This paper focuses to identify the vehicle's shape and its motion between the consecutive frames. Detection and tracking can be carried out with the help of Image registration, Image feature extraction, vehicle shape detection and vehicle tracking [5]. Image registration helps to transform different set of frames in to one co-ordinate system which eliminates the camera motion and consider only vehicle motion. Since the UAV capture images from higher than 100m from ground level, the large amount of data may cause errors. To avoid such errors a few road elements used as a matching points. Image feature can be extracted by edge, optical flow and local feature point [5].

Edge is used to identify the points in a digital image at which the image brightness changes sharply whereas optical flow describes about the pattern of any clearly visible motion of objects. Local feature point is used to detect and describe about the position and angle of vehicle in each frame. Two different vehicles may be considered as a single vehicle when optical flow alone taken in to account. In order to avoid this along with optical flow, edge detection also taken in to consideration during vehicle shape detection. Vehicle can be tracked continuously with the help of occlusion database [5].

Youyang Qu et al [6] proposed the paper "Moving vehicle detection with convolutional networks in UAV videos"This paper focuses on convolutional neural network which helps target detection and vehicle screening. By employing image registration movement of the vehicle can be detected. A successful detection of moving vehicle can be obtained by training a variety of data sets. Moving vehicles can be classified in to two different motions are rectilinear and rotational. Target of the vehicle can distinguished from background by frame difference algorithm which classifies the pixels in to two categories as target and background. After acquiring the target image, it is essential to segregate the vehicle from background with the help of trained neural network[6].

III. VARIOUS TYPES OF VEHICLE DETECTION TECHNIQUES

A. Fuzzy based vehicle detection

In this scheme of road vehicle detection, a vector mask will be applied to the vehicles which need to detect the road region. By this pre-processing method, the image will extract the road vehicle from the entire scene of the road. From the heterogeneous set of objects, the segmentation will allows the identification of vehicle objects from the pre-processing method [7]. Based on the user defined set of rules or logics, vehicle objects can be detected and separated from the other objects. It is possible to identify the vehicle objects and fuzzy classification system allows separating the type of vehicle [7].

B. Radar and V2V fusion technique

In this scheme, the vehicle can be detected with the help of on-board cameras, radars or any other detecting elements. Those detecting elements may have certain limitations like angle of view, detection range [8]. Vehicle can transmit its own GPS information like position, velocity and acceleration via DSRC to nearby vehicles instead of detecting vehicles at all times. If every vehicle is equipped with radar sensor then it transmits the vehicle information to the connected vehicle not only through radar, it also transmits via DSRC [8].

C. Background subtraction technique

Static cameras and fixed background are generally involves in the video sequences of surveillance system. But in the moving objects point of view, each frame of the video is compared with background. During the required object detection there is a possibility of false detection because of variation in illumination, background motion or shadows present during the extraction of original foreground objects [9]. For the effective detection of objects, it is necessary to remove those misclassified illumination and shadows. Each pixel from the image which is captured from the video sequences is classified as stationary and non-stationary[9]. Background model formation is the first step in the effective object detection in which stationary pixel alone taken in to account. A problem arises while choosing stationary pixel is that variation of illumination, movement of background objects, waving of leaves in a tree etc. It is necessary to distinguish the object and shadow with the aid of intensity range [6]. In the second step the required object can be detected and extracted properly by setting a local threshold value.

D. Object detection by active contour method

In this method the main outlines are segmentation, tracking, rectangular initialization and geodesic active contour deformation [10]. Geodesic describe about the shortest line between two points on a specific surface. Extracting only the moving objects and after extracting, detecting and separating those moving objects is a challenging task. In this technique, the moving object can be detected by converting the video sequences in to succession of images. The time difference of those images gives a moving pixel. Geodesic differs from conventional active contour method is that; it may detect several objects internal and external borders. Initially rectangular boundary is generated and its size and position kept constant. Several points are marked inside and outside of the rectangle in order to detect all kinds of moving objects [9,10]. These points are moving and optimized towards the moving objects.

E. Single learning based detection method

This method extracting and detecting the various kinds of objects like cars, traffic signs and cyclists. Once the dense area has been extracted then it will pass the information to all the detectors. By a single extraction all the three different classes of objects can be identified so that the detection speed can be improved [11]. When the detection process of an object, it is initially preceded with two ways. Whether the object detected in a single phase or using a sub-categorization method. If it is implemented with sub-category method then individual detectors are used to identify each sub-category like the shape, orientation, aspect ratio and occlusion. All the sub-category information must be evaluated and merged together during the training phase [11]. Viola and Jones framework provides the excellent detection results on a rigid body. However in a vehicular environment, the detection of an object not only in the form rigid body, it contains various forms of moving objects. So, it is necessary to concentrate on those moving object with subcategory of that object. On a moving objects environment the Viola and Jones framework performance goes down. Compared with Viola and Jones framework method, single learning based detection method gives better results[11].

IV. CONCLUSION

In this paper discussed about the various types of vehicle detection techniques.

Technique	Inference
Fuzzy based Vehicle Detection Technique	Extraction and Segmentation of vehicle objects is carried out with the help of preprocessing method.
Radar and V2V fusion Technique	Vehicles transmit their position, velocity and acceleration information to the connected vehicles via various sensors associated with it.
Background Subtraction Technique	In Background model formation, Stationary pixel alone considered. The required object detected and extracted by setting a threshold value.
Object detection by active contour Technique	Detection of moving objects by video sequences in to succession of images.
Single learning based detection technique	By single extraction, three different classes of objects are identified.

Table- I: Various methods of moving object detection techniques

By using a defined set of fuzzy rules, the detection of vehicles from the various different types of objects is possible. Radar and V2V method utilizes its own on-board sensors like cameras or radars and GPS information obtaining from other vehicles. But this method had certain limitations like angle of view and detection range. Since vehicle detection is to be carried out in the continuous moving object environment, each frame which is obtained from the video sequences the exact vehicle alone to be detected by subtracting the unnecessary things like illumination, shadows, leaves of the trees and etc. Moving pixels can be identified by the succession of images from the video sequences. Detection of internal and external borders of several objects can be done by geodesic active contour method. Sometimes detection of objects alone not sufficient, it is very important to analyze its sub-category like shape, orientation and other parameters. Those sub-categories are merged later to detect the object accurately. These various techniques have their own way of advantages. Collaboration of various above mentioned technique may improve the detection of vehicles.

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